ORBITAL
MARINE POWER

Document Title:

Tidal Turbine Mooring Proposal – Deer Sound

Author(s):

James Murray, Daniel Wise

Release Date:

11/11/2019

Summary:

Orbital Marine Power (Orkney) plc will deploy the Orbital O2 2MW tidal turbine at the EMEC Fall of Warness test site in Orkney in 2020 for a long-term deployment of up to 17 years. In order to perform certain maintenance tasks on the turbine or infrastructure on site, the O2 2MW turbine will need to be removed for varying periods of time. It is proposed that a simple mooring is established in a sheltered location, and a location in Deer Sound has been selected for this purpose. A Marine Licence Application for Moorings and a Crown Estate sea bed lease is to be applied for. This document is to support the Marine License Application.

Rev.	Date	Author(s)	Check	Notes
A	11/11/2019	JM	DW	

Contents

1 Introduction

The O2 tidal turbine, a twin rotor, contra-rotating floating tidal turbine 73m in length, will be installed at the EMEC Falls of Warness tidal testing site in Orkney in 2020 for a long-term deployment of up to 17 years. In order to perform certain maintenance tasks on the turbine or infrastructure on site, the O2 turbine may need to be removed for varying periods of time. Owing to its configuration, berthing at a pier such as Hatston is impractical. It is proposed that a simple mooring is established in a sheltered location, and Deer Sound has been selected for this purpose.

No generation activity will take place at any point while the turbine is moored at Deer Sound.

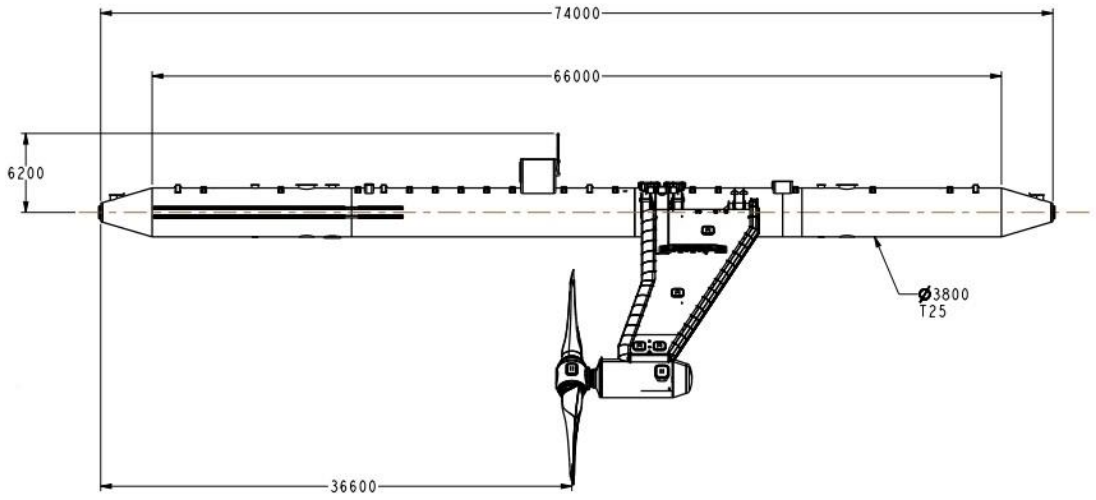
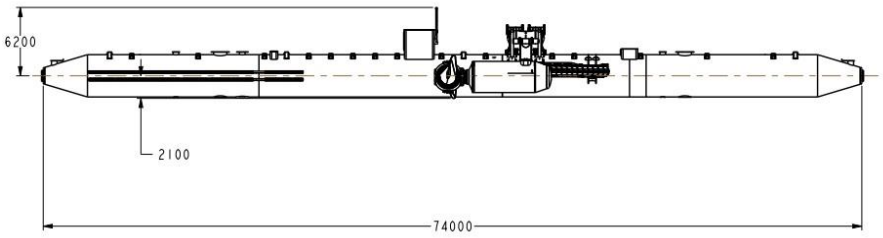


Figure 1 Orbital O2 in operational mode



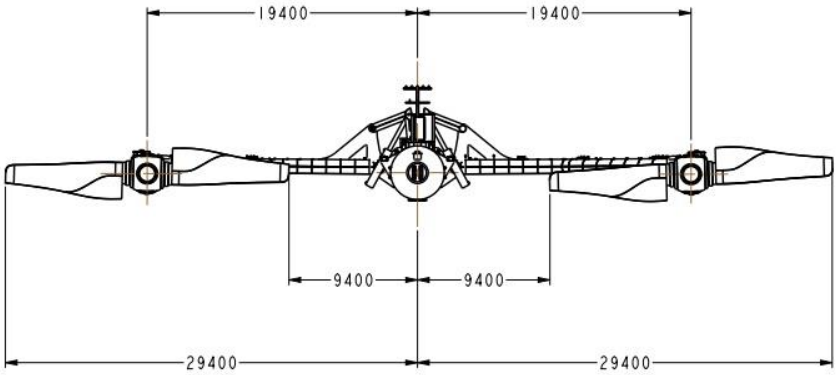


Figure 2 Orbital O2 in transport mode

Orbital Marine's SR2000 tidal turbine is currently moored in a similar arrangement at Inganess Bay. For clarification, the SR2000 will be removed from this location before the end of 2020, such that there will be a single offsite mooring location in place for Orbital's tidal technology in Orkney.

Orbital are requesting a licence from 1st August 2020 to operate at the Deer Sound site to 31st December 2039 in line with the maximum period of operation of the O2 project, including decommissioning phase and in line with the marine license duration for the O2 project.

Orbital Marine are seeking permission from Marine Scotland and The Crown Estate to undertake these works.

2 Consultation

Prior to application submission, the proposal has been discussed with Crown Estate Scotland and Orkney Islands Council - Harbour Authority. No concerns were raised.

3 Mooring Location

The mooring will be located in Deer Sound which lies out with the Orkney Harbour Authority limits. The location is sheltered from most directions, but susceptible to North Easterly directions. An area on the West side of the Sound has been selected as the preferred location (see anchor symbol in Figure 1). Within this area a specific location has been selected, but there is scope to microsite within the area of search if required.

Mooring	Latitude Degrees/Dec min	Longitude Degrees/Dec min
Mooring location	58 57.735N	2 48.479W
Site boundary- NW corner	58 57.844N	2 48.698W
Site boundary- - SW corner	58 57.626N	2 48.698W
Site boundary- - NE corner	58 57.844N	2 48.268W
Site boundary- - SE corner	58 57.626N	2 48.268W

The turbine would have a maximum excursion of 100m when on the mooring as shown in Figure 3 below by a 100m radius circle around mooring centre. A second red circle is also shown at 200m around mooring centre as a proposed buffer.

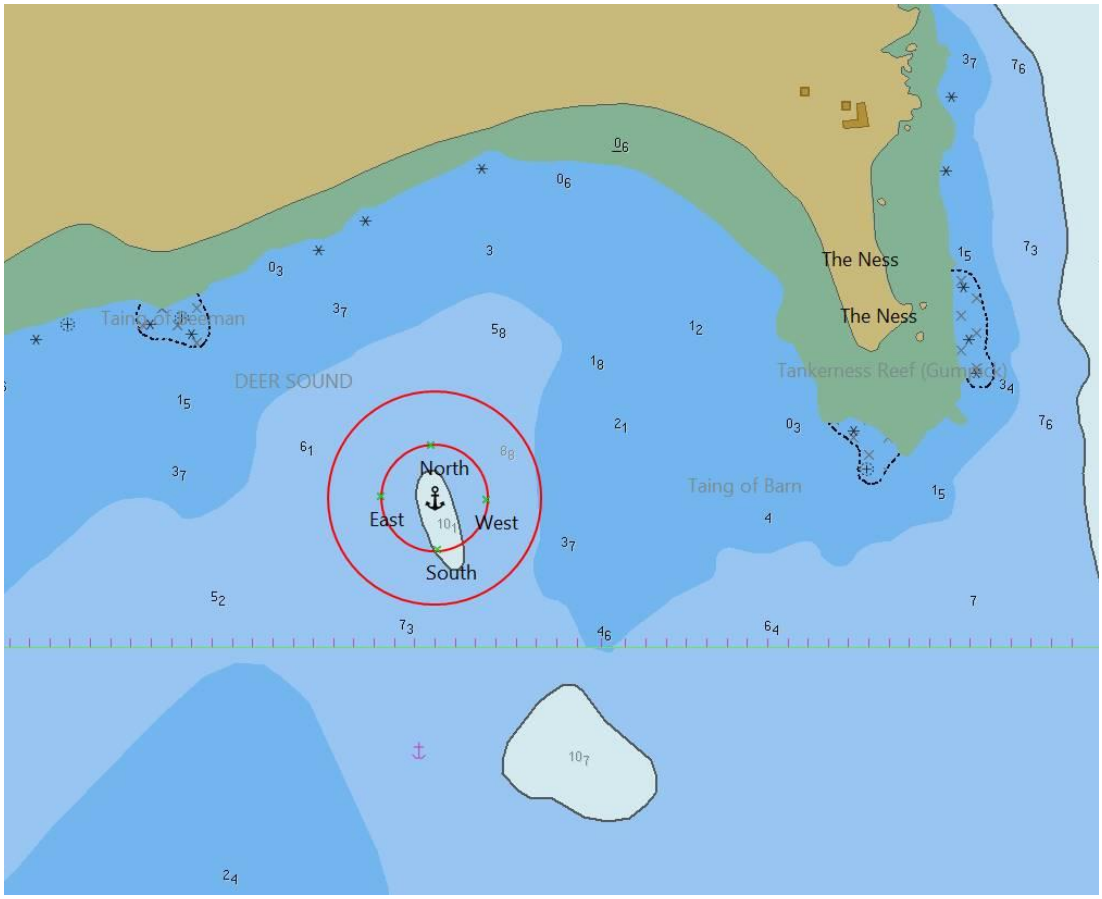


Figure 3: Location of survey at Mooring centre (Anchor symbol) – following by survey 100m North, South, East and West of mooring centre – shown by green squares. 200m buffer shown by second red circle.

Figure 4: Mooring centre [58° 57'. 732N 002° 48'. 474W] – Depth at time of survey = 11m. Seabed made up of muddy sand with evidence of *Arenicola marina* casts

Figure 5: 100m North of Mooring centre [58° 57'. 790N 002° 48'. 480W] Depth at time of survey = 11m. Seabed made up of muddy sand with evidence of *Arenicola marina* casts

Figure 6: 100m South of mooring centre [58° 57'. 683N 002° 48'. 467W] Depth at time of survey = 11m. Seabed made up of muddy sand with evidence of *Arenicola marina* casts

Figure 7: 100m west of mooring centre [58° 57'. 735N 002° 48'. 370W] Depth at time of survey = 11m. Seabed made up of muddy sand with evidence of *Arenicola marina* casts

Figure 8:100m East of mooring centre [58° 57'. 738N 002° 48'. 579W] Depth at time of survey = 11m. Seabed made up of muddy sand with evidence of *Arenicola marina* casts.

3.1 Environmental Conditions

Based on Orbital's experience of the area it is expected that the tide will be less than 1.5 knots. Maximum wave height in a winter gale would be expected to be H_m=1m, and during summer months H_m=0.5m.

To be conservative a wave height of H_m=2m at the resonant period of the turbine and tide of 2 knots have been used as the design environmental conditions to size the moorings.

4 Mooring Design

The mooring system will be designed using the same Orcaflex model that was reviewed by DNV-GL as part of the Prototype Certification of the SR2000, and validated against measured SR2000 data. The turbine will be moored with a single point mooring connected to the front mooring connector.

4.1 Mooring Loads

Using conservative design loads of 2 knots of tide and significant wave height of 2m swell, with period matching to the resonant period of the S2000m, the peak load at the anchor in the design environmental conditions is 12 Tonnes. Applying a load factor of 1.3 give maximum load expected of 15.6T

4.2 Anchor

A chain clump weight will be used for the anchor. Assuming a friction coefficient of μ=0.5 on a sandy seabed gives a required weight of at least 30T.

4.3 Chain

A length of 50m of 56mm stud link chain (MBL=248T) will be used to connect the turbine to the anchor, providing a good catenary mooring.

4.4 Turbine Mooring Point

A mooring bridle shall be connected directly to the main mooring lifting frame on the turbine, which is rated for lifting 60T, and is a sufficiently strong structure on the turbine for mooring from. There shall be a large mooring swivel (SWL 60T) installed between the mooring chain and the turbine connection so that it can be accessed for inspection and maintenance.

4.5 Marking

The turbine will be predominantly yellow in colour and has a freeboard of 1.5m. When at anchor, it is proposed that the turbine has 2 yellow flashing navigation lights with the sequence Fl.Y.3s.

There are also two radar reflectors situated at either end of the turbine to provide a clear radar presence.

When the turbine is not attached to the mooring, the mooring chain end will be marked with two small un-lit polyform A3 orange buoys.

5 Proposed Works

5.1 Mooring Installation

Installation of the single point mooring shall be carried out by a suitable workboat e.g Multicat by lowering the large clump weight using the mooring chain until all chain is on the seabed. A riser rope shall be attached to the chain end with two A3 orange marker buoys with Orbital marked on each of the buoys. All equipment shall be mobilised from Hatston Pier and can be carried out in a single day.

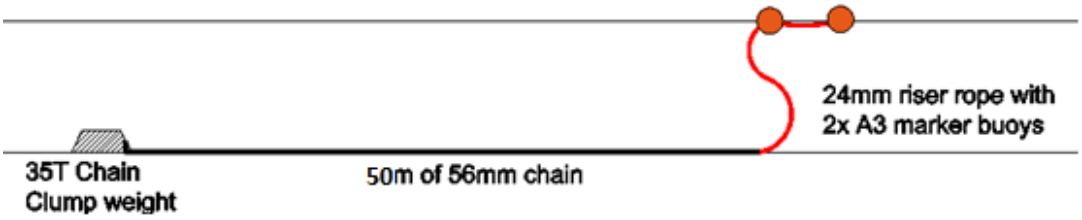


Figure 9: Illustration of mooring with marker buoys

5.2 Schedule of Works

Installation of the Mooring is planned to take place in 2020 between April and June and is expected to take 1 day. The mooring would remain in place initially for the duration of the O2 project i.e. to 2039.

5.3 Installation of Turbine to Mooring

As this is intended to serve as a maintenance mooring, the connection and disconnection of the turbine to the mooring could happen at any point in the future, but notice to mariners of the operations shall be promulgated with as much notice as possible, via the following authorities:-

- Orkney Harbours – Vessel Traffic Services (VTS)
- Shetland Coastguard
- Orkney Fisheries Association
- Orkney Fisheries Society
- UK Hydrographic Office (UKHO)
- European Marine Energy Centre (EMEC)

6 Use of Mooring Facility

6.1 Accessing site

During towing and mooring the rotors will be fully retracted (see Section 1). The device will be towed by the multicat vessel to the site, attached to the mooring system, and the vessel will then return to harbour. Any subsequent trips to the mooring site will be made using a RHIB.

6.2 Frequency of use

The frequency of use and the length time the turbine will be at the mooring site could vary considerably depending on the nature of the maintenance issue.

6.3 Monitoring of Turbine

The turbine is visible from the shore, and shall be visited regularly by staff via a RHIB vessel. The turbine access hatches shall be secured using pad locks and chains. All auxiliary systems on board the turbine shall be shut down and secured so that they cannot be run by unauthorized persons. Only essential systems shall remain activated (bilge pumps, communications systems and position monitoring).

7 Potential Impacts

Potential impact on designated sites - The proposed site is in a sheltered bay over 5km from the nearest designated conservation area (Mull Head Local Nature Reserve).

Collision risk between marine mammals and device rotors - The tidal device will not be generating at any time, so the rotors will be permanently retracted and stationary.

Potential conflict with other sea users - The proposal has been discussed with Orkney Islands Council – Harbours and Crown Estate Scotland and no concerns raised. The site is well away from any ferry and main shipping routes. The tidal device will be well lit and clearly visible to any small vessel users who may use the area.

It is intended that through the marine licensing application process that other sea users such as fisheries and the aquaculture sector would be consulted.